

Comparing nurses' knowledge retention following electronic continuous education and educational booklet: a controlled trial study

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Abstract

Background: Training methods that enhance nurses' learning and retention will increase the quality of patient care. This study aimed to compare the effectiveness of electronic learning and educational booklet on the nurses' retention of diabetes updates.

Methods: In this controlled trial study, convenience sampling was used to select 123 nurses from the endocrinology and internal medicine wards of three hospitals affiliated to Tehran University of Medical Sciences (Tehran, Iran). The participants were allocated to three groups of manual, electronic learning, and control. The booklet and electronic learning groups were trained using educational booklet and electronic continuous medical education (CME) website, respectively. The control group did not receive any intervention. In all the three groups, the nurses' knowledge was measured before the intervention, and one and four weeks after the intervention. Data were collected by a questionnaire.

Results: Significant differences were observed between the mean scores of the three groups one and four weeks after the intervention ($F=26.17$, $p=0.001$ and $F=4.07$, $p=0.020$, respectively), and post hoc test showed that this difference was due to the higher score in e-learning group. Both e-learning and booklet methods could effectively improve nurses' knowledge ($\chi^2=23.03$, $p=0.001$ and $\chi^2=51.71$, $p=0.001$, respectively).

Conclusion: According to the results of this study, electronic learning was more effective than booklet in enhancing the learning and retention of knowledge. Electronic learning is suggested as a more suitable method as it provides appropriate interactions and attractive virtual environments to motivate the learners and promote retention.

Keywords: Knowledge, Nursing Care, Distance Education, Booklet, Continuing Medical Education.

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Introduction

According to adult learning theory, learning is a self-directed activity requiring motivation, desire, and effort on the part of the learner (1). In fact, it comprises intellectual activities, including recognition and remembering, which relate to what learners should know and understand (2). Remembering generally involves reviving what a person has learned and retained. More specifically, it is the process of recollection

and retention through which past memories are remembered in the form of words, meanings, actions, or mental pictures. As learners tend to absorb meaningful, conceptual, and new subjects more deeply, such subjects are expected to be forgotten more slowly (3). Andrusyszyn defined knowledge retention as recalling materials 25.5 days after learning (4).

Despite its importance, retention of knowledge and skills has rarely been stud-

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ied (4-8). Because problems related to the retention of nursing knowledge and skills have been documented, selecting the best training method will definitely depend on identifying any factors that may contribute to the problem (9). Research has shown that teaching accompanied by colors, illustrations, and animation (dynamic content) can enhance the understanding of the material, learners' ability to organize the concepts, and retention of knowledge (10-12).

Continuous training after graduation aims at maintaining the acquired skills, qualitative and quantitative promotion of such skills, and teaching new scientific contents and skills. Continuous education programs include seminars, congresses, workshops, conferences, short professional courses, well-organized plans, as well as training, research, and self-education activities (13).

Internet-based continuous education offers electronic, learner-centered, self-learning courses intending to promote knowledge (14-17) through the engagement of multiple senses (18).

Educational booklets are also widely used as the first generation of self-directed learning media. However, during their preparation, readability for the target group, presence of simple pictures and diagrams, bold-facing important words and phrases, including up-to-date information, and using reliable sources have to be considered. On the other hand, previous studies have reported the insufficiency of educational booklets and thus suggested e-learning as a more favorable choice (19,20).

Electronic Continuous Education Website uses interactive scenario-based-learning approach. Scenario-based e-learning can improve participants' engagement and deeper understanding of content by motivating them to think and analyze before making decisions (11,21). In Addition, electronic continuous medical education (eCME) facilitates learning using a constructivist orientation. Constructivism is a learning paradigm, which explains how people learn. According to this theory, people learn by constructing their own training

experiences (22). Constructivism seeks to associate new knowledge with previously learned information. Therefore, instead of transferring knowledge from an educator to a learner, constructivism focuses on learners and assists them to create knowledge and give it an individual meaning (23,24). Electronic continuous medical education (eCME) encourages learning through active involvement with valuable information and provides a responsive learning environment (with questions and answers) and learner-centered teaching (6,9,23,25).

Integration of e-learning and continuous medical education implies that in adult medical education, trainers are not merely the distributors of content but act as learning facilitators. E-learning improves retention, provokes better use of the content, and consequently increases the accessibility of knowledge, attitude, and skills (14,26).

The relationship between nursing education and nursing services is growing steadily (27). In addition, the production of nursing knowledge is on a constant rise (27,28). Hence, nursing educators are constantly trying to teach learning methods to their students. The ultimate goal in professional nursing is to provide high-quality biological, psychological, and social care to patients. Therefore, surface learning and incomplete information will affect the performance of the nurses in dealing with patients, and may lead to patients' complaints, and managers' concerns. To prevent such problems, nursing educators should use modern teaching methods to prevent surface learning and promote t students' critical thinking, problem solving, and information retention skills (27). Evidently, better learning of educational materials on the part of nurses will increase the quality of patient care (29).

While time constraints placed on nurses is a challenge that prevents them from updating their knowledge, the flexibility of distance education may be a good solution for organizations; i.e., the knowledge of nurses can simply be completed, modified, and updated through distance education system.

Distance-learning delivery methods can range from paper-based to internet-based materials and their impact is not clearly stated.

Therefore, this study aimed to compare the efficacy of educational booklets and the electronic continuous medical education system on enhancing the retention and deep learning of the recent advances in diabetes. As no similar study was found in this field, conducting this research seemed necessary.

Methods

This quasi-experimental study aimed to compare nurses' ability to retain diabetes updates, which was learned through the electronic method and booklet. Considering the power of 80% with a confidence level of 95%, the needed sample size was about 120. Convenience sampling was used to select 123 nurses from endocrinology and internal medicine wards of three hospitals affiliated to Tehran University of Medical Sciences (Tehran, Iran). These three hospitals had the largest number of patients and nurses in the ward.

The inclusion criteria were at least one year experience of working in endocrinology and internal medicine wards, a minimum of bachelor's degree in nursing, having finished obliged service in remote areas, having access to computers and the internet at home or workplace, and being skilled at working with the internet (according to the participants themselves). At any stage of the study, nurses who were not willing to participate, or were transferred to other wards were excluded.

The eligible nurses were allocated to e-learning (n=38), booklet (n=43), and control groups (n=42). To prevent information exchange between the participants, each group was selected from a different hospital; that is, the names of the hospitals were written on paper and randomly selected.

To measure nurses' knowledge before the intervention, all groups were asked to fill out a researcher-made questionnaire about diabetes updates (pre-test). The booklet and e-learning groups received the educational

content in the form of a booklet and eCME (<http://cme.tums.ac.ir>), respectively. To develop educational materials, extensive library research, and domestic and international website search were conducted. The educational content was prepared using up-to-date articles, reliable sites and new educational books. The training content includes muscular and skeletal complications of diabetes such as diabetic hand syndrome, frozen shoulder syndrome, diabetic diet, desired levels of glucose control, insulin and its complications, new treatments for diabetes, common diabetes skin diseases and diabetic foot ulcers. The content was given to 14 outstanding professors and their corrective comments were applied. Then the materials were prepared in two formats of booklet and eCME. Educational objectives and titles were identical for both groups. Using illustrations and tables, the colored booklet of diabetes updates was prepared and given to the manual group. For the electronic group, interactive problem-based scenarios were developed, and the content was placed on CME website after the administrative procedures (confirmed by two reviewers and after obtaining a license from The National Continuing Education Office of Ministry of Health and Medical Education) in collaboration with electronic continuing education center at Virtual School of Tehran University of Medical Sciences. The e-learning group also attended a 30-minute session to learn how to log in to the website and how to use the program.

In the e-CME group, after coordinating with Hospital authorities and obtaining the required permissions, with the assistance of the hospital's information technology team, a 24/7 service was provided and the e-learning group could access the website without interruption regardless of time or day. Moreover, to facilitate access to the educational material at the endocrinology and internal wards of the hospital, the website was set as the homepage in "Mozilla Firefox" and "Microsoft Internet Explorer". The control group did not receive any in-

tervention. One week and one month later, the questionnaires were distributed among all the three groups again without notice.

The pre and post-test were identical. The questionnaire consisted of two parts: The first part included demographic characteristics of the participants, while the second part assessed knowledge about diabetes updates. The last part was a researcher-made questionnaire to assess knowledge about diabetes updates. It contained 30 multiple (three-four) choice items with one positive score each. The items' scores were summed up and calculated out of 100. Scores ≥ 75 , 74-51 and ≤ 50 represented favorable, moderate, and low levels of knowledge, respectively. The questionnaire evaluated knowledge about desirable glucose control (nine items), insulin and its complications (four items), complications of diabetes (four items), diabetic diet (four items), musculoskeletal complications of diabetes (four items), novel treatments of diabetes (two items), common dermatological manifestations in diabetics (two items), and diabetic foot ulcer (one item).

The questionnaire was designed according to the conditions and features of the training program, and through library research and review of the literature including the "University of Michigan Diabetes

Knowledge Questionnaire" (30). The validity of the whole questionnaire was assessed by expert review; i.e., it was handed out to 10 faculty members of School of Nursing and Midwifery (TUMS, Tehran, Iran), and their comments were applied. To evaluate the test-retest reliability of the questionnaire, 10 nurses with similar characteristics to those of our participants were asked to complete the questionnaire twice, with a two-week interval. The reliability coefficient of the questionnaire with test-retest was then calculated ($r=0.91$). It should be noted that these people were excluded from the study.

The results were finally analyzed using variance and chi-square, Fisher's exact, Friedman, and Tukey's test; and $p < 0.05$ was considered as statistically significant.

Results

We studied 123 nurses in three groups (booklet, e-learning, and control). The mean age of the booklet, control, and e-learning groups was 30.6 ± 5.3 , 32.5 ± 5.5 , and 29.4 ± 5.2 yrs., respectively. The three groups were compared using Fisher's Exact Test and Chi-square analysis, and no statistically significant demographic differences were found. Demographic characteristics of the three groups are presented in Table 1.

Table 1. Frequency Distribution of Demographic Characteristics of the Nurses in the Three Groups

	Groups			Significancy*
	Booklet (n=43)	eCME (n=38)	Control (n=42)	
Gender (female)	40 (93.0%)	41 (97.6%)	36 (94.7%)	P= 0.680
Academic degree (bachelor)	42(97.7%)	38 (100%)	42 (100%)	P= 0.999
Computer skills (good)	27 (62.8%)	15 (39.5%)	25 (59.5%)	P= 0.060
Work experience (less than 5 years)	17 (39.5%)	21(55.3%)	17(41.5%)	P= 0.570

* Fisher's Exact test was used to analyze data related to gender, academic degree and computer skills; and ANOVA for work experience.

Table 2. Descriptive Statistics of the Scores before the Intervention, and One and Four Weeks after the Intervention for the Three Groups

Type	Before		After one week		After four week		p**
	N	Mean Sd	Mean Sd	Mean Sd	Sd		
Booklet	43	20.0 2.15	21.9 3.64	19.4	5.62	p=0.001	
eCME	38	19.4 3.56	24.1 3.72	20.8	3.56	p=0.001	
Control	42	18.9 2.88	18.1 3.95	18.0	3.50	p=0.310	
p*		p=0.211	p= 0.001		p=0.020		

*ANOVA was used to test for the differences between the mean scores of the three groups (eCME, booklet and control).

** Friedman was used to determine significant differences in the dependent mean scores of each group (before, after one week and after four week).

The mean (SD) of the pretest and posttest scores for the three groups are shown in Table 2. While the mean scores of the three groups were not significantly different before the intervention ($p=0.211$), significant differences were observed between the mean scores of the three groups one and four weeks after the intervention ($F=26.17$, $p=0.001$ and $F=4.07$, $p=0.020$, respectively). Friedman analysis revealed that both electronic learning and booklet methods could effectively improve nurses' knowledge ($\chi^2=23.03$, $p=0.001$ and $\chi^2=51.71$, $p=0.001$, respectively), but no significant difference was found in the pre and posttest scores in the control group ($p=0.31$).

Tukey's test revealed that the mean scores of knowledge were significantly higher in the e-learning group than in the booklet group ($p=0.024$) and the control group ($p=0.001$) one week after the intervention. The e-learning group had significantly greater mean score of knowledge compared to the control group ($p=0.014$) four weeks after the intervention, but the difference was not significant between the mean scores of e-learning and booklet groups ($p=0.328$).

Discussion

In this research, we compared the effects of booklets and e-learning on nurses' retention of knowledge about diabetes updates. We found that e-learning could significantly improve nurses' knowledge compared to the control group; in addition, results suggested more desirable retention rate following e-learning.

In support of the above findings, Short et al. found that continuous medical education programs could effectively change the knowledge, attitude, beliefs, and self-reporting behaviors of the physicians. They reported these changes to last for more than 12 months (6). Tsai et al. found e-learning (with multimedia) to significantly increase the level of knowledge after one and two weeks ($p<0.001$) (31). Bloomfield et al. compared the effects of computer-assisted

learning and traditional face-to-face methods on learning and retention of hand washing skills. They concluded that although knowledge scores increased significantly in both groups, knowledge obtained through computer-assisted learning was better retained (7). Yaghoubian et al. indicated that the use of manuals failed to increase the mean scores of knowledge three weeks after the intervention. In fact, the mean scores decreased from 8.55 before the intervention to 8.47 three weeks after the intervention (19).

E-learning is established based on constructivism in which knowledge is not simply transferred from an educator to a learner, but it is instead learned through the creation of associations between the existing knowledge and new information and giving it an individual meaning. E-learning increases retention, improves the use of the content, and thus leads to better access to knowledge (14,32,33).

Soleimanpour et al. did not observe a significant difference between e-learning (using information and communications technology) and traditional learning (through lectures) immediately and one month after intervention. However, the third post-test (three months after the intervention) showed a significant difference between the two groups. Hence, they stated that teaching science based on information and communications technology results in sustainable knowledge in students of the third grade of junior high school (17). In contrast, the Aleman et al. showed that when compared to traditional teaching, e-learning led to significantly higher level of knowledge immediately after the intervention. Nevertheless, the retention of knowledge was similar in both groups 10 weeks after the intervention (8).

Sustainable learning occurs when the learner is able to organize and relate new concepts and information with his/her mental cognitive structures (27,34). E-learning encourages the learners to participate in learning actively and thus engages them with the content. Interactive learning

changes the focus from passive, teacher-centered methods to active, learner-centered methods and results in more efficient learning (14).

In conclusion, the review of the literature on retention indicated they are few especially on knowledge retention; for example, Aleman in 2011 examined knowledge retention in medical surgical nursing students (8). Two other studies examined the retention of practical skills including Beeckman who studied students' retention in bedside care in 2008, and Bloomfield who studied the retention of hand washing in 2010 (33,7). Inadequacy of studies on retention makes the conclusion difficult and indicates the need for further studies in this field.

Conclusion

Considering the results of studies on eCME and the results of this research, it can be stated that eCME can effectively promote nurses' knowledge and retention. Therefore, eCME systems can be used as an alternative or supplement to traditional teaching (e.g., booklets and lectures) in continuous education for nurses. This method enhances learning and retention by active engagement of the learners in the learning process through an interactive scenario. It facilitates learning by associating previously obtained knowledge with new information. Superficial learning and incomplete information will affect the performance of nurses in dealing with patients, resulting in patient complaints, and leading to real concerns for nursing managers. Apparently, the quality of nursing care can be increased by promoting the knowledge of nurses.

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